5-105.2

2689

AREA 8, PHASE II
NATURAL RESOURCE RESTORATION
DESIGN PLAN

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

DECEMBER 1999

U.S. DEPARTMENT OF ENERGY
FERNALD AREA OFFICE

21100-PL-0001
REVISION B
DRAFT

000001

TABLE OF CONTENTS

000002

2689

000003

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

A1PIII	Area 2, Phase III
A8PII	Area 8, Phase II
A8PIII	Area 8, Phase III
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
FDF	Fluor Daniel Fernald
FEMP	Fernald Environmental Management Project
IEMP	Integrated Environmental Monitoring Plan
NRRDP	Natural Resource Restoration Design Plan
NRRP	Natural Resource Restoration Plan
ODOT	Ohio Department of Transportation
OEPA	Ohio Environmental Protection Agency
QAJSP	Quality Assurance Job-Specific Plan
S&H	Safety and Health
SCS	Soil Conservation Service
SEP	Sitewide Excavation Plan
USDA	U.S. Department of Agriculture

1.0 INTRODUCTION

The Fernald Environmental Management Project (FEMP) is a former uranium processing plant owned by the U.S. Department of Energy (DOE) that is undergoing extensive environmental remediation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). DOE is liable under CERCLA for injuries to natural resources resulting from a release or threat of release of hazardous substances. DOE, in concert with other CERCLA-appointed Natural Resource Trustees (Trustees), are actively working to resolve DOE's liability through implementation of natural resource (i.e., ecological) restoration projects integrated with the CERCLA remedial action process.

The FEMP Trustees have tentatively agreed to an approach for restoration of the site as set forth in the Natural Resource Restoration Plan (NRRP; DOE 1998a). The NRRP establishes the components of ecological restoration projects at the FEMP, and provides conceptual plans for 12 separate restoration projects, along with an implementation schedule for the majority of the 1,050-acre site. This Natural Resource Restoration Design Plan (NRRDP) for Area 8, Phase II (A8PII) is the third of the 12 natural resource restoration projects planned across the site. The NRRDP includes all of the details and information necessary to implement, monitor, and maintain the ecological restoration of A8PII.

1.1 PROJECT OVERVIEW

Ecological restoration of A8PII will consist of the establishment of several types of habitat native to southwestern Ohio, including three different forest types and an oak savanna. Also, the existing riparian corridor will be expanded and enhanced. A 4-acre materials handling area will be established within A8PII as well. This area will be used to temporarily stockpile woodchips and other organic materials for use in this and other ecological restoration projects. Components of the materials handling area include the addition of a gravel access road and several drainage swales to control runoff. The swales drain to a series of vernal pools that will remove organic matter from the surface water runoff. An additional small vernal pool will also be constructed to provide available habitat for amphibians.

1.2 SITE DESCRIPTION

A8PII is a 20-acre grazed pasture located on-property in the northwest corner of the FEMP site. It is bounded to the west by Paddys Run Road, and to the east by Paddys Run (Figure 1). A8PII lies within the historic floodplain of Paddys Run, and an existing riparian corridor is present along the length of

000006

the A8PII reach. A cultivated farm field borders the site off-property to the north. The southern boundary consists of a drainage ditch that flows west to east toward Paddys Run, adjacent to train tracks that provide rail access to the FEMP. Until recently, A8PII was leased to a farmer by DOE and used to graze cattle. The site is part of a predominantly rural, agricultural landscape. A mosaic of cropland, deciduous hedgerows, and small patches of successional hardwood forest make up the surrounding area.

1.2.1 Topography

The topography of A8PII has been altered in several locations. It appears from historical aerial photographs and the current site topography that approximately 6 feet of soil has been removed from a good portion of the materials handling area (Figure 1). A 1954 aerial photo shows a significant amount of earthwork being conducted in this area. Also, shovel tests across A8PII in support of the cultural resource survey (conducted in November 1999) confirmed that the area had been disturbed.

The main water feature across A8PII is a man-made ditch used to control surface water runoff. It is configured in a straight line running west to east across A8PII towards Paddys Run (Figure 1). The drainageway has begun to meander near the confluence with Paddys Run. This ditch appears on early aerial photos (ca. 1950), so it has been in place for some time. This ditch drains residential and agricultural land west of the FEMP boundary. A second drainage ditch that runs parallel to the railroad tracks constitutes the southern boundary of the A8PII ecological restoration area.

In areas where the A8PII topography has not been significantly altered (i.e. south of the drainage ditch), rolling slopes set back from an historic floodplain terrace are present. These features are typical along Paddys Run at the FEMP. In general, all of A8PII drains to Paddys Run.

A good portion of A8PII lies within the 100-year floodplain of Paddys Run. However, actual floodplain habitat is limited because of the steep cut banks located along much of the western edge of Paddys Run that allows flooding only when something close to the 100-year flood event occurs.

1.2.2 Vegetation

Much of A8PII is characteristic of grazed pasture. Isolated patches of trees exist across the site. These patches, which are represented on Figure 2 as "Existing Forest," consist of black cherry (*Prunus*

serotina), sycamore (*Platanus occidentalis*), cottonwood (*Populus deltoides*), silver maple (*Acer saccharinum*), boxelder (*Acer negundo*), honeylocust (*Gleditsia triacanthos*), red cedar (*Juniperus virginiana*), and American elm (*Ulmus americana*). The understory and shrub layer within these areas is limited primarily to multiflora rose (*Rosa multiflora*). Typical pasture grasses such as fescue (*Festuca spp.*) and bluegrass (*Poa spp.*) are present across A8PII. Some noxious weeds are present (i.e., thistle), but tall ironweed (*Vernonia fasciculata*) is present in good numbers within some areas where the topsoil is intact.

Woody vegetation is more dense along the Paddys Run riparian corridor. These areas (shown as "Existing Riparian" on Figure 2) include black walnut (*Juglans nigra*), chinquapin oak (*Quercus muhlenbergii*), Ohio buckeye (*Aesculus glabra*), shellbark hickory (*Carya laciniosa*), osage orange (*Maclura pomifera*), sycamore, boxelder, and hackberry. As with the pasture areas, the woody understory and shrub layers are dominated by multiflora rose and bush honeysuckle (*Lonicera mackii*). A closed canopy and leaf layer has built up in some areas, resulting in suppression of pasture grasses. However, grazing has apparently limited the formation of a woodland herbaceous layer.

1.2.3 Soils

Soils throughout the site are mapped by the Soil Conservation Service (SCS) as deep, well drained, with no serious limitations to the establishment of trees. All of the soils are described as ranging from slightly acid to slightly alkaline, a range conducive to establishment of almost all plants indigenous to southwestern Ohio. The SCS considers all of the soils within A8PII as good candidates for the establishment of upland forest and wildlife habitat (SCS 1980). All of the soils are well drained and considered poorly suited for wetland establishment, so a small amount of clay may need to be imported to hold water in the vernal pool.

The majority of A8PII is mapped as Genesee loam. Genesee soils are described as deep, nearly level, well-drained soils typical of floodplains. Soils in the Genesee series are well suited to establishment of a broad spectrum of plants other than those associated with the wettest and driest of sites (SCS 1980). It should be noted that most of the historic topography alterations in A8PII has occurred within the Genesee soils. However, the materials handling area occupies the majority of the scraped area, so most planting areas are not affected by the loss in topsoil.

A narrow band of Henepin silt loam is located along Paddys Run. Hennepin soils are described as deep, well drained, and typically found on slopes along streams (SCS 1980). Most of the Hennepin soils found in A8PII have existing woody vegetation in place.

Uniontown silt loam is found on the southwest portion of A8PII along Paddys Run Road. Uniontown soils are described as deep, gently sloping, and well drained (SCS 1980). Uniontown soils are well suited for the establishment of grasses; thus, an oak savanna is planned for corresponding areas in A8PII.

Surface soil was sampled in the summer of 1999 to evaluate soil quality characteristics. The findings from this effort reinforced the SCS descriptions except for an area with low pH (5.6) in the northwest corner of the site. This result was attributed to intense livestock operation, since a cattle feeding trough and holding pen were located near the sample location. A high concentration of cow manure is visible in this area. All other areas within A8PII had pH ranging from 6.8 to 7.8. Soil samples taken in A8PII shows that organic material in the soil averaged around 3 percent.

1.2.4 Hydrology and Wetlands

No part of the site was identified as wetland during a sitewide wetland delineation of the entire FEMP property completed in 1993 (Ebasco 1993). None of the three soil series mapped on the site (Genesee, Hennepin, or Uniontown) are classified as hydric soils. Surface water features are limited to the two drainage ditches cutting across the bottom third of A8PII, and Paddys Run along the eastern edge of the project area (Figure 1). These features are described in Section 1.2.1.

1.2.5 Wildlife

Wildlife use of A8PII is typical of grazed pasture and open woodlands. Facemire et. al. (1990) provide a comprehensive list of wildlife present at the FEMP, including A8PII. Several threatened and endangered wildlife species have been found within A8PII. The federally-endangered Indiana bat (*Myotis sodalis*) has been identified along the Paddys Run corridor on the eastern edge of the project site. Also, the state-threatened Sloan's crayfish (*Orconectes sloanii*) is located within Paddys Run. Revegetation and erosion control measures are considered in this NRRDP in order to protect and enhance the habitat for these special-status species.

1.3 REMEDIAL ACTION STATUS

A8PII has undergone soil certification pursuant to the Sitewide Excavation Plan (SEP; DOE 1998b). Since A8PII is located in a remote area of the FEMP, primarily upgradient and upwind of the Former Production Area, no contaminated soil was anticipated and the area was sampled for soil certification. As expected, certification samples revealed that no contamination was present, and A8PII achieved "Certified Area" status on September 23, 1999.

1.4 RELATIONSHIP TO THE NRRP CONCEPTUAL RESTORATION APPROACH

The general goals for ecological restoration at the FEMP will be met through this project. These goals include the establishment of native, presettlement plant communities and the enhancement of wildlife habitat (DOE 1998b). However, the functional objectives specific to A8PII restoration have been refined since the last submittal of the NRRP. Originally, A8PII reforestation was described simply as a combination of upland forest and riparian forest establishment. For this NRRDP, revegetation has evolved to include specific forest types found throughout the region. An oak savanna, which was not discussed in the NRRP, has also been added. Lastly, the materials handling area was not envisioned in the NRRP, but was determined necessary for this and future restoration projects across the FEMP.

2.0 DESIGN COMPONENTS AND GOALS

This section describes the major components and goals for A8PII ecological restoration. In general, there are two main phases: construction of the materials handling area and revegetation of the remainder of the site. These components are discussed in more detail below.

2.1 MATERIALS HANDLING AREA

A materials handling area will be constructed in order to manage excess woodchips generated from other projects across the FEMP to be used in the restoration of Area 8, Phase III (A8PIII). Since the material handling area will be used as a staging area for incoming plant material, it must be constructed before revegetation efforts in A8PII can begin. Therefore, construction of the material handling area has been broken out into a separate phase of the project, and implementation is planned for Fall 1999.

Soil in the materials handling area is less suitable for ecological restoration than other portions of A8PII due to the prior disturbance of that area. The use of the area for organic material handling and management will result in the improvement of soil quality over time. The approach for restoring this portion of A8PII when the location is no longer needed for organic material management is presented in Section 4.2.8 of this NRRDP.

2.2 REVEGETATION

Pursuant to the NRRP, revegetation of A8PII is designed to restore presettlement plant communities native to southwest Ohio. Figure 2 shows the location of the habitat types to be restored in A8PII. These include three forest types (oak-maple, beech-maple, and mesophytic), and an oak savanna, as well as enhancement of the existing riparian corridor. A visual buffer area and a small grassland patch are also included in the vicinity of the materials handling area.

2.2.1 Forest Types

Several references have been used to determine the appropriate plant communities, including Braun (1950), Gordon (1966, 1969), Harker et. al. (1998), Sears (1925), and Yahner (1995). As stated above, forest types chosen for A8PII ecological restoration include beech-maple, oak-maple, and mesophytic. On a large scale, the FEMP is located in a transition zone between these forest types. This transition is driven by several major historic changes in climate and geology, which are briefly discussed below.

Glaciation is a major factor in the distribution of forests across Ohio (Braun 1941, Yahner 1995). Following the last period of glaciation – the Wisconsin – changes in climate dictated the formation of the forest types present today. After the Wisconsin Glacier retreated (around 15,000 years ago), a warming and drying trend occurred. This period resulted in the eastern expansion of the tallgrass prairie and oak-hickory forest (Braun 1941). Over time, the climate became more humid, and a more diverse deciduous forest developed and expanded into prairie areas (Braun 1934). Several of these dry to moist shifts in vegetational composition have occurred over time, resulting in the assemblage of forests over glaciated areas that are present today. In contrast, unglaciated areas have not experienced the dramatic changes in soil composition, topography, and moisture that glaciers caused. Forests in unglaciated areas have had much more time to develop into the complex, diverse systems that are present today (Braun 1941). This historical context has led to the selection of the specific forest types to be established in A8PII.

2.2.1.1 Mesophytic Forest

The mixed mesophytic forest has developed in unglaciated areas with adequate moisture. Perhaps the best example of this type of forest is found in the Allegheny and Cumberland mountains and plateaus (Braun 1941). Farther west is a broad transition to the drier oak-hickory forest. Braun (1950) terms this transition zone the "western mesophytic forest." Western mesophytic and mixed mesophytic regions are differentiated by Gordon (1969), particularly in the extensive referencing of Braun's work. Gordon does not make a distinction of the two forests types on his 1966 map of Ohio's vegetation. The mesophytic forest plots proposed in this NRRDP were developed to reflect the western mesophytic forest types described by Gordon (1969) and Braun (1941).

Southwest Ohio represents the southern edge of Wisconsin glaciation. Because of this, mesophytic forests typically are limited to dissected portions of earlier Illinoian glaciation, where adequate moisture is present (Braun 1950). The increased development time afforded by the mesophytic forest has led to a very diverse assemblage of plants that lack any particular dominant species. Table 3 shows that the A8PII mesophytic forest type consists of more species (36) than any other forest type.

2.2.1.2 Beech-Maple Forest

The beech-maple forest represents the climax community of glaciated areas. Braun (1941) describes the beech-maple forest as the "northern mesophytic expression of the deciduous forest." Shade-tolerant

beech (*Fagus grandifolia*) were able to take over the established oak-hickory forests once moisture increased after glaciation (Braun 1934). Sugar maple (*Acer saccharum*) co-dominates this forest type, except where moisture is too great. This appears to be a primary area of distinction between beech-maple and mesophytic forest. Sugar maple comprises 25 to 50 percent of beech-maple forest and less than 1 percent of mesophytic forest (Braun 1950). This distinction is reflected in the A8PII forest-type planting lists (Tables 3 and 4).

2.2.1.3 Oak-Maple Forest

The oak-maple forest type represents a drier component of post-glacial forests. In this area, the formation of the Oak-maple forest is similar to that of the beech-maple forest, except that complete transition to beech-maple is limited by comparatively dry conditions (Harker et. al., 1998). The oak-hickory forest type became dominant in the Ozark and interior plateaus as temparatures rose and humidity levels dropped in the middle of North America (Gordon 1969). Post glacial periods of drying encouraged the eastward and northward movement of the oak hickory forests with the northwestern extent of the movement residing in southwest Ohio (Braun 1941). Oak-sugar maple forests are characterized by Gordon (1969) as the expression of the oak-hickory forest that dominates this portion of southwest Ohio.

2.2.2 Oak Savanna

Oak savanna represents a transition between tallgrass prairie and oak-hickory forest (Packard 1997). As discussed above, these habitats moved north and east as conditions became warmer and drier following glaciation. At one point, at least 300 prairies were present across Ohio (Gordon 1969). Almost all have been destroyed, with only isolated remnants existing today. Oak savannas were found in Wisconsin till plains in the western portion of the state (Gordon 1969). Native Americans maintained some areas as savannas through periodic burning. Packard (1997) shows that the transition areas from prairie to forest extended from western Kentucky and southern Indiana into southwestern and central Ohio, and that the glacial till that composes local soils provides an excellent opportunity for oak savanna restoration.

2.3 PLANTING STRATEGY

A restoration approach has been developed for A8PII that takes into account elements of soils, topography, hydrology, and ecological succession. The main considerations that drive the restoration approach are discussed below.

2.3.1 Habitat Type Placement

In general, since A8PII is composed of similarly-derived soils, the location of forest types is driven by hydrology. The mesophytic forest occupies relatively wetter areas, while the oak-maple is located in drier portions of the project area (Figure 2). This habitat placement through hydrological gradient is also related with topography. The drier oak-maple forest is located on elevated sites, while the beech-maple forest is located on slopes and the mesophytic forest in low-lying areas. The topography is appropriate for the beech-maple and oak-maple forests, but not ideal for the mesophytic forest. Braun (1950) limited the location of mesophytic forests around Cincinnati to steeper sloped areas. However, given that A8PII is considered a demonstration project that illustrates forest types across the FEMP, the mesophytic forest is included.

The oak savanna is situated in an area that provides a gradient from a drier hilltop to streamside habitat (Figure 2). This arrangement is appropriate, since oak savannas can be found in a wide range of conditions (Packard 1997).

A visual buffer area has been strategically placed to screen the view of the materials handling area from Paddys Run Road (Figure 2). This placement is driven by aesthetics rather than habitat requirements. However, all species used in the buffer planting are appropriate for the topography and hydrology present.

2.3.2 Selection of Species

Specific species to be planted within each plant community were determined through Braun (1961), Facemire et. al. (1990), Hamilton County Park District (1998), and the Ohio Environmental Protection Agency (OEPA 1998). Table 1 lists the master plant list for A8PII. Plants were excluded from use in A8PII if they were not listed in at least one of the references above. A special effort was made to include species listed in the 1819 land survey of Crosby Township (OEPA 1998). This early record of local vegetation is a good source for the composition of presettlement plant communities.

2.3.3 Planting Densities

Ideal planting densities should be obtained from local reference information (Harker et. al. 1998). Reference information was collected in support of the Wetland Mitigation Design. This effort resulted in an average density of 430 plants per acre (Munro 1999). The overall planting densities for A8PII forests

approximate these findings. By adding the number of saplings per acre (165), one-half of the seedlings per acre (200), and the shrubs per acre (92), the desired forest planting density is reached. These densities are discussed in greater detail below.

2.3.3.1 Saplings

Sapling trees will be planted at a density of 165 trees per acre. Large-scale planting of sapling species is expensive and is not commonly practiced in ecological restoration (Harker et. al. 1998). However, there are several benefits to the use of sapling species in this project. First, deer browsing impacts are minimized. Saplings are too tall to be completely browsed. Second, sapling trees will produce the desired canopy closure and self-propagation much sooner than seedling species. For instance, white oak (*Quercus alba*), a mast-producing tree which will be planted in all three forest types, may produce viable seed within 20 years (Rogers 1990). By planting saplings, the benefits of mast production (propagation, wildlife forage, etc.) will be gained almost twice as fast. Saplings also immediately provide perches for birds, thus hastening the recruitment of volunteer plant seed dispersal (Sauer 1998). The use of natural bird perches has proven successful in increasing seed dispersal on other restoration projects (Holl 1998). Lastly, saplings do not compete with grasses and weeds for similar resources.

2.3.3.2 Seedlings

Tree seedlings will be planted at a density of 400 per acre. The use of seedlings in addition to saplings will provide the immediate advantage of age stratification. An uneven-age stand of trees is most similar to what is found naturally and thus provides a greater benefit for wildlife (Yahner 1995). The establishment of seedlings also lessens the dependence of volunteer recruitment to increase overall stem densities. Seedlings are more susceptible to drought, competition from grasses and weeds, and deer browsing. Therefore, seedlings are planted at roughly twice their ultimately desired density. The exact species mix of seedlings will be determined by availability and will consist of 75 percent dominants and 25 percent associates for each forest type. Blue Ash (*fraxinus quadrangulata*) and chestnut (*castanea dentata*) seeds will be either directly planted or grown and transported into mesophytic and beech-maple patches. The exact number will be determined by seed availability.

2.3.3.3 Shrubs

Shrub species will be planted at a density of approximately 92 per acre. This density was obtained from the forest restoration design for the Ecological Restoration Park (DOE 1998c). Roughly half of the forest

=- 2689

patches will not be planted with shrubs. This approach will allow for several research efforts that will benefit future restoration work at the FEMP. First, some unplanted patches will be surveyed to determine the extent of volunteer recruitment. Several variables may be factored, including the use of native ground covers and the effectiveness of invasive species control. The effects of deer browsing may also be investigated through the use of exclusion fencing and deer repellents.

2.3.3.4 Oak Savanna

The oak savanna is designed at a much lower density than the forest types. This habitat will be planted at a density of 34 trees and 34 shrubs per acre (OEPA 1999). All the trees planted will be large sapling size. No seedlings will be planted, in anticipation of periodic burns as part of maintenance.

2.3.3.5 Existing Riparian Forest

The existing riparian woods will be planted at an average density of approximately 40 trees and 40 shrubs per acre. This density is lower than the forest type density because of the presence of existing trees. No seedlings will be planted in the riparian forest.

2.3.4 Grasses and Forbs

All planted areas will be seeded with a native mix of grasses and/or forbs, with the exception of the existing riparian forest. Table 8 lists the grass mix for the forest types while Table 9 lists the oak savanna grass and forb species and Table 10 lists wetland species for use in the vernal pools. Existing grasses will be eradicated prior to seeding with the use of herbicide. Two applications are planned, one in Fall 1999 and one in Spring 2000.

2.3.5 The Role of Ecological Succession

Forest restoration is a long-term process. Even if large sapling species are planted at a high density, it will still take many years for a closed canopy to develop to the extent that pasture grasses and forbs are excluded and a leaf layer builds up. It will take even longer to develop the age stratification and canopy gap characteristics of a mature forest. Therefore, it is important to understand, and to the extent possible manage, the dynamics of ecological succession.

The management of ecological succession is an effective tool in the process of ecological restoration (Luken 1990, Sauer 1998). This NRRDP encourages volunteer recruitment in order to maximize the

beneficial effects of succession. It is expected that volunteer tree and shrub species will invade the area. Except for a few invasive species, plant recruitment is accepted and even encouraged. The establishment of wind and bird dispersed plant species quickly increases woody plant coverage over an area. Pioneer species such as cottonwood, black locust (*Robinia pseudoacacia*), sycamore, and red cedar readily invade degraded and unmanaged sites such as abandoned pasture. This process favors the growth of later successional species that take advantage of the increases shade, organic matter, etc. While the composition of the planted woodland is altered in the near term, it lessens the time needed to reach the ultimately desired system. The existing forest patches indicated on Figure 2 are primarily early-successional pioneer species.

It should be noted that later-successional species are not excluded during the early phases of forest development. The current accepted model of ecological succession illustrates that later successional species are present at the outset of succession. However, they do not assume a dominant role until early-successional species develop favorable conditions (Pickett et. al. 1987). Therefore, it is not counter productive to plant later-successional species (e.g., beech) at the outset of restoration. For mast producing trees this is actually a benefit, because it compensates for the much slower dispersal of seed. This approach can be witnessed onsite within Area 1, Phase III (A1PIII). This agricultural land was obtained as FEMP property in 1950. Apart from periodic mowing in the 1950s and 1960s, the area appears to have been left alone. Since that time, a single shellbark hickory shade tree has produced a fairly large grove of pole-size, seed-producing hickory trees. Also, the strip of forest along the western edge of A1PIII has expanded east to cover approximately one third of the 107-acre tract of land. Most studies of ecological succession management involve the use of seeds or seedlings rather than saplings (Luken 1990). However, anectdotal evidence from areas on FEMP property indicates that a lighter density of sapling plantings will facilitate quicker development of forest.

3.0 GRADING PLAN

Grading requirements for A8PII consist of two main components; access into the area and road construction, and surface water runoff control from the materials handling area. A vernal pool will also be constructed in order to diversify habitat within A8PII. Each component is discussed in more detail below.

3.1 ACCESS

Access into the material handling area will consist of a gravel road, suitable for use by semi-trailers, with sufficient area to turn around. Figure 3 shows the location of the access road and turnaround area. This access road will be used to deliver plant material for A8PII restoration, as well as woodchips for stockpile and management to and from other FEMP restoration projects.

3.1.1 Grading Requirements

Earthwork for access construction will require the cut of approximately 750 cubic yards of soil to lessen the slope from Paddys Run road into the materials handling area. The access road grade will be leveled everywhere else. Minimal leveling is anticipated to the existing topography, except where several trees will need to be cleared.

3.1.2 Road Construction

The access road will consist of a typical gravel construction road used across the FEMP. This type of construction will include the placement of a geotextile liner, covered by Ohio Department of Transportation (ODOT) Type 304 crushed limestone aggregate. Approximately 700 square yards of geotextile liner and 400 tons of limestone aggregate will be required to construct the 400-foot access road. Proper drainage along the road must be maintained. This is particularly important with respect to protection of existing monitoring wells that are shown on Figure 3. The road construction must not result in surface water runoff toward the wells. Also, drainage along Paddys Run road must not be altered. Butler County will issue any requirements through their road access permitting program.

3.1.3 Fence/Gate Modifications

An existing gate will be utilized for access control into the project area. The existing perimeter fence will be set back from the road in order to allow for easier access by larger vehicles.

3.2 MATERIALS HANDLING AREA

The materials handling area will be used to stockpile woodchips and other organic material generated from FEMP activities for use during ecological restoration projects. The area encompasses approximately 4 acres (Figure 2). Approximately 32,000 cubic yards of woodchips can be stockpiled within the material handling area. However, only that needed for completion of A8PII and A8PIII is anticipated to be stored there. This amount of woodchips is estimated at less than 2,000 cubic yards. Woodchips will be delivered to the area via dump truck and managed in piles and windrows. Stockpiles will be turned as necessary to reduce odor and fire hazard. A portion of the materials handling area may be used in the future for staging and/or growing plant stock for other restoration projects. Details regarding plant stock staging/growing would be submitted in future NRRDPs.

3.2.1 Grading Requirements

Earthwork will be required to control runoff from the material handling area. Figure 3 shows the location of four shallow drainage swales that direct runoff into a series of vernal pools. Two pools outflow to a shallower third pool that is designed to filter out suspended organic matter prior to release into the restored mesophytic forest type. Approximately 1,200 cubic yards will be moved to construct these drainage features.

3.3 ADDITIONAL VERNAL POOL

An additional vernal pool will be constructed at a location to be determined within the mesophytic and/or existing riparian forest types. This feature consists of a shallow depression approximately 10 feet in diameter and 3 feet deep that will become inundated with water during wet periods in the spring and fall. Several types of amphibians should benefit from this additional habitat.

The general location of the vernal pool is identified on Figure 3. The amount of soil removal required to excavate a 10-foot diameter, 3-foot deep depression formed on level ground is approximately 40 cubic yards.

3.4 FIELD IMPLEMENTATION

As stated in the Introduction, construction of the materials handling area has been broken out into a separate phase of the ecological restoration of A8PII. All earthwork and construction activities will take place in the fall, while revegetation efforts will take place in Spring 2000. The intent is to use the

completed materials handling area as the primary access and staging area for all revegetation efforts in the spring. In order to take advantage of the mobilized heavy equipment, the additional vernal pool discussed in Section 3.3 will be constructed as well.

3.4.1 Roles and Responsibilities

All earthwork and construction activities will be conducted by FDF through the utilization of their onsite construction services contractor. FDF will ensure that all applicable policies, procedures, and regulations will be met in the planning and implementation of the work. DOE and the other Trustees have approval authority for this NRRDP.

3.4.2 Soils Handling

An excess of soil from grading is anticipated. All topsoil (6 inches deep) within grading areas will be removed and stockpiled within the materials handling area. Excess subsoil will be wasted as generated within the materials handling area without any alteration in drainage patterns. Topsoil will be replaced within each drainage swale and the vernal pools. Soil amendments will not be needed for this project.

3.4.3 Revegetation

Revegetation for this portion of A8PII ecological restoration is limited to interim grass cover over all disturbed soils. A seed mix consisting of 23 pounds per acre Regreen and 2 pounds pure live seed per acre partridge pea will be applied via seed drill, hydroseeder, and/or hand broadcast. Straw mulch will be applied to all hand seeded areas. Permanent seed mix will be drilled into areas after they are established (Table 8).

3.4.4 Sequencing

All earthwork for the road access and runoff control will be undertaken first, followed by road construction and fence/gate modifications. Drainage swales and the vernal pools will be constructed next. The additional vernal pool construction will occur last. Seeding of all disturbed areas will occur after all the earthwork is complete.

4.0 PLANTING PLAN

This section describes the specific approaches that will be used to plant the various habitats and features specified for A8PII.

4.1 PLOT DESIGN

Figure 4 shows the location of forest and savanna patches for A8PII. Each patch is comprised of a distinct mixture of native vegetation. As stated in Section 2.3.3.3, shrubs will be planted in approximately half of the patches. Details regarding the selection of forest types, species mixes, and planting densities can be found in Section 2.0 of this NRRDP. The specific habitat type patches are described below.

4.1.1 Oak-Maple Forest

The oak-maple forest type is comprised of four patches located in the northern portion of A8PII (Figure 2). Table 2 provides the list of species to be planted in each patch. This forest type encompasses approximately 1 acre of A8PII. Because a cattle feeding trough and holding pen was located within this area, it has seen the highest concentration of cows across the site. Surface soil samples collected in the summer of 1999 showed that the soil in this area was slightly acidic (pH = 5.6). Therefore, an application of lime may be required to raise the soil pH prior to planting. A decision will be made regarding this or any other soil amendments prior to field implementation. Any potential soil amendments must be evaluated to ensure that CERCLA soil certification will not be compromised.

4.1.2 Mesophytic Forest

The mesophytic forest type is comprised of 11 patches totaling approximately 2.8 acres along the length of A8PII (Figure 4). It is the largest and most diverse forest type to be planted. Table 3 provides the list of species to be planted in each patch. The materials handling area wetland will outfall into several mesophytic forest patches.

4.1.3 Beech-Maple Forest

The beech-maple forest type is comprised of eight patches totaling approximately 1.8 acres (Figure 4). Table 4 provides the list of species to be planted in each patch. Plantings of this forest type are dominated by American beech and sugar maple. Several patches are located within the scraped area

discussed in Section 1.2.3. To compensate for this, excess topsoil resulting from road access and drainage construction may be spread across patches BS23 through BS26 during the Fall 1999 grading work.

4.1.4 Oak Savanna

The oak savanna is comprised of ten patches totaling approximately 2.5 acres (Figure 4). Table 5 provides the list of species to be planted in each patch. Bur oak (*Quercus macrocarpa*) dominates this habitat type, which is planted at a much lighter density than the forest types. Large-size saplings (greater than 2 inches caliper diameter) will be planted in order to withstand periodic burning. The northern drainage described in Section 1.2.1 bisects the savanna habitat type. Plantings will be adjusted to account for the streamside conditions.

4.1.5 Buffer

A single 0.25-acre aesthetic barrier will be planted in order to reduce the visibility of the materials handling area (Figure 4). Table 6 lists the species that comprise the buffer. A large proportion of red cedar will be planted in a high density within this patch.

4.1.6 Existing Riparian Forest

The existing riparian forest comprises approximately 4.4 acres along Paddys Run on the eastern edge of A8PII (Figure 4). The forest will be enhanced through five existing patches. Table 7 provides the list of species to be planted in each patch. The planting list is designed to supplement rather than replace existing trees. The one exception is osage orange, which is non-native. All osage orange located in the riparian forest will be girdled and left in place to create snags. Shellbark hickory and shagbark hickory (*Carya ovata*) will be planted in this (and other forest types) to facilitate Indiana bat habitat.

4.1.7 Erosion Control Areas

Five cow paths have been cut into the western bank of Paddys Run. Pursuant to the NRRP, these erosion-prone areas will be repaired through bioengineering techniques. Coir fabric will be staked over eroded areas, and dormant willow cuttings will be planted on 2-foot centers throughout the area. An equal mix of black willow (*Salix nigrum*) and silky willow (*Salix sericea*) will be planted in each area. Several paths are narrow, deeply incised channels. These areas will be repaired by the use of branch packing.

4.1.8 Vernal Pools

As stated in Section 3.2.1, drainage from the materials handling area will be diverted into two small pools that will outflow into a shallower vernal pool (Figure 3). This drainage feature will serve to filter out organics accumulated in woodchip stockpile runoff. These pools and an additional vernal pool constructed during Fall 1999 should provide habitat for amphibians and reptiles. It is anticipated that these pools will hold water during periods of increased rainfall. The areas will be seeded with the interim grass mix in the fall, then interseeded with native grasses on the spring.

4.2 FIELD IMPLEMENTATION

Planting activities for A8PII are scheduled to begin in Spring 2000. Some planting may be delayed until Fall 2000 if specified plant material or suitable substitutes cannot be acquired for spring planting. The completed materials handling area will be used as a staging area for all plant material and associated equipment and materials. All revegetation efforts will take place in accordance with the procedures outlined below.

4.2.1 Roles and Responsibilities

All revegetation activities will be conducted by FDF through their onsite labor force. FDF will ensure that all applicable policies, procedures, and regulations will be met in the planning and implementation of the work. DOE and the other Trustees have approval authority for this NRRDP. FDF will assign a Restoration Ecologist that is responsible for coordinating the handling, planting, maintenance, and monitoring of A8PII vegetation.

4.2.2 Planting Window

The planting window extends from the approval of this NRRDP through May 15, 2000. It is anticipated that all plant material will be installed from March to May. If all planting is not completed by May 15, 2000, planting will be suspended until the fall planting window starting on October 1, 2000. If some material can be purchased before Spring 2000 and the weather is permitting, revegetation of some stock may occur sooner. Plants will not be installed if the ground is frozen. The Restoration Ecologist will determine whether conditions are appropriate for planting.

4.2.3 Sequencing

The planting sequence is designed to minimize travel through completed patches. Balled and burlapped and container grown stock will be planted in the existing riparian forest patches first, followed by the mesophytic patches, the beech-maple patches, the oak-maple patches, the savanna patches, and the buffer. The erosion control work will be conducted next. All areas will then be seeded. Lastly, seedlings will be planted across the entire area. Plant material orders have been staggered to accommodate this approach.

Ideally, each patch will be completely planted before the next one is undertaken. However, alterations in the sequence may occur due to plant material delivery. Installation of plant material will take precedence over maintaining the proper sequence of patches. In other words, trees and shrubs will usually be planted as soon as possible after delivery in order to minimize the time a plant spends out of the ground.

4.2.4 Plant Material Availability/Substitutions

All plant material for A8PII was ordered in Fall 1999, when availability was high. However, there is no guarantee that all the specified plant species, quantities, and sizes will be procured. Plant bid packages include the possibility of substitutions proposed by the vendor. Each tree and shrub species was assigned a substitution category that any substitution must meet in order to fulfill the same habitat role as the original species. Substitution categories include cover, mast, diversity, aesthetics, and fruit. No cultivars, hybrids, or plants non-native to southwest Ohio will be accepted as substitutes. It may be necessary to adjust plant quantities in order to meet the desired densities within each patch.

4.2.5 Planting Procedure

Each habitat patch will be flagged for species placement by the Restoration Ecologist. Usually, species will be randomly distributed throughout the patch. A few species will be specified for a clumped distribution, where several of the individual plants are placed closely together. The Restoration Ecologist will adjust species locations according to patch-specific hydrological and topographical conditions.

All plant material will be installed in accordance with the specifications included in Appendix A. In general, laborers will dig sapling planting holes mechanically or by hand, install the plant to the appropriate height, backfill by hand, and water. Transport materials (flagging, twine, etc.) will be

removed prior to installation. Slow release fertilizer tablets will be placed in each planting hole at the manufacturer's specified rate.

Seedlings will be randomly placed by the laborers under the supervision of the Restoration Ecologist. Seedlings will be planted by hand with a dibble bar or spade. All bare-root seedlings will be inoculated with microrhizal inoculate prior to planting.

A 70-foot "no plant zone" will be established around Air Monitoring Station No. 7. This area is required pursuant to the Integrated Environmental Monitoring Plan (IEMP; DOE 1999), so that air monitoring measurements will not be affected by nearby trees.

Erosion control areas along Paddys Run will have dormant cuttings staked by hand into coir fabric on 2-foot centers. For the narrow gullies, branch packing will be used. This technique consists of installing alternating layers of dormant cuttings and compacted backfill at 6-inch intervals for the length of the gully. Cuttings are laid in a criss-cross formation, with the basal ends lower than the growing tips and touching undisturbed soil on the gully bed (SCS 1992).

4.2.6 Mulching

All planted vegetation will be mulched prior to project completion. Tree saplings and shrubs will receive a woodchip mulch ring at least 4 feet in diameter, 4 inches thick. Seedlings will receive a mulch ring at least 2 feet in diameter, 4 inches thick. Mulch will not be piled against the stem of the vegetation.

4.2.7 Seeding Procedure

All planting patches (except for the existing riparian forest patches) will be seeded with a native grass and forb mix after all plant material is installed. The seed mix for the oak savanna is listed in Table 9, while the seed mix for all other forest types is listed in Table 8. The vernal pool seed mix is listed in Table 10.

All existing grasses will be sprayed with herbicide prior to planting in the spring. If possible, all areas that will eventually be seeded will be raked to scarify the soil surface. Individual patches will be seeded after all tree saplings and shrubs have been installed, but before seedlings are planted. Forest types and the wetland will be broadcast seeded with a carrying medium such as sand. A small grassland strip

(GL32) will also be seeded by hand. The oak savanna will be seeded with the onsite seed drill. Since existing dead grasses will be left in place, seeded areas will only be straw-mulched in bare soil areas.

4.2.8 Restoration of the Materials Handling Area

The materials handling area will be restored once it is no longer needed for material handling to support FEMP ecological restoration. A revegetation plan will be produced that is similar to the planting plan in this NRRDP. Soils will have already been amended as a result of woodchip stockpile management. Therefore, the plan will consist primarily of establishing forest and/or savanna habitats across the materials handling area. The uneven age of restored habitats resulting from the later restoration will further increase diversity within A8PII. The access road will used as a public and/or maintenance access if determined necessary.

5.0 MONITORING AND MAINTENANCE

Monitoring and maintenance will be carried out to ensure that the restoration of A8PII is successful and meets the stated goals of the project. All monitoring and maintenance will be carried out by the FDF Natural Resource Team utilizing site labor as needed with oversight provided by DOE.

5.1 MONITORING

Monitoring will carried out in two phases. The initial phase of monitoring will last 3 years (2001 – 2003) and will focus on the survival of the tree sapling and shrub species planted. The second phase of monitoring will last 6 years (2004 – 2009) and will be less intensive, focusing on the continued growth of the trees and general useage of the area. Monitoring will be focused on the planted saplings and shrubs only. Seedlings will be overplanted assuming 50 percent mortality to reach the desired stem density per acre. Because the seedlings will be overplanted and a high mortality is expected, no quantitative monitoring is being proposed.

5.1.1 Near-Term Success Criteria

The near-term success criteria is based on the survival of the trees and shrubs that are planted. The goal of the project as explained earlier in this design is to plant the right mix and density of plants to help accelerate the natural succession process. The first step towards successfully reaching that goal is to ensure survival of planted material. The results of the monitoring outlined below will be submitted to the Natural Resource Trustees by August 1 in each of the first 3 years of monitoring. The first monitoring report will be due by August 1, 2001.

5.1.1.1 Saplings/Shrubs

For the first 3 years after planting, monitoring will be carried out to ensure 80 percent survival of all planted saplings and shrubs. Each planted forest, savanna and riparian plot must maintain 80 percent survival of saplings and shrubs with the exception of selected patches that will not receive applications of deer repellant sprays as part of a study to determine mortality due to deer browsing. The severity of deer browsing in patches that do not receive treatment with deer repellant will be compared with the extent of browsing damage in the treated patches to determine the intensity of deer control warranted for this and future forest restoration projects. Due to the absence of repellant sprays in these patches,

relatively high mortality rates are expected and may exceed 20 percent of the planted shrub and sapling population.

Monitoring will be carried out once per year in early summer to determine the amount of plant material living. Mortality counts will be conducted in each planted plot. If a tree sapling or shrub has failed to leaf out at the time of monitoring, it will be considered dead. Any plot that has less than 80 percent survival of planted saplings and shrubs will require the planting of replacement species to bring the number of living saplings and shrubs up to a number not less than 80 percent of the original number of saplings and shrubs planted in the plot. After monitoring is conducted in early summer, any required replacements will be ordered and planted in the fall of the same year. In the event that replacements can not be received during the fall planting window, replacement planting will occur the following spring.

5.1.1.2 Grasses

There will a requirement for 90 percent coverage of grasses at the end of the first growing season after project completion. All disturbed areas (e.g., area adjacent to parking areas and the access road) will be seeded as specified in Section 4.2.7. Seeding will also occur in all of the forest plots and in the savanna. The coverage requirement will not apply to the riparian corridor or the material handling area. The disturbed portions of the project, the forest plots, and the savanna will be monitored to ensure that 90 percent cover is achieved.

Percent cover will be determined pursuant to the methods used in the Wetland Mitigation Project (Munro 1999). If 90 percent cover is not achieved, additional grasses will be interseeded into growth grasses at a rate to be determined.

5.1.1.3 Invasive/Aggressive Species

The presence of invasive species will be identified during the monitoring carried out from 2001 – 2003. The invasive species of concern include, but are not limited to the following: bush honeysuckle, wild grape, multiflora rose, thistle (*Cirsiun spp.*) and garlic mustard. Management to extirpate honeysuckle, wild grape and thistle will be carried out as described in Section 5.2.2.1. Other invasive species will be managed only if significant problems develop as determined by DOE in consultation with the Natural Resource Trustees on a case-by-case basis.

5.1.2 Long-Term Monitoring Parameters

The long-term monitoring parameters will focus on the continued growth of the saplings and the use of the area by wildlife. The monitoring will be conducted every other year for a period of 6 years to ensure that the saplings are growing within normal parameters. The long-term monitoring will occur in 2005, 2007 and 2009. The saplings will be the focus of the long-term monitoring since the development of the forest canopy is a key element in the natural succession process. The other important indicator regarding the long-term health of the system is the type of wildlife that is using the area and the presence of invasive/aggressive species being established in the restored area.

5.1.2.1 Sapling Growth

For 6 years following the initial 3-year monitoring period, growth of the saplings will be monitored in the forest plots and in the savanna. The growth of the saplings will be measured by taking caliper readings and measuring stem growth on 10 percent of the saplings in each forest plot and 10 percent of the saplings in the savanna. The measurements will be conducted in mid-summer in each of the monitoring years. Baseline caliper readings will be taken in the summer of 2003 to serve as a basis for comparison during the monitoring events. Trees selected for the baseline caliper reading will be flagged with weatherproof tags and will comprise the 10 percent monitored in the following 6 years. The results of the baseline caliper readings will be presented in the monitoring report prepared in 2003. Reports from the long-term monitoring events will be submitted by September 1 in each of the 3 years that monitoring is conducted (i.e., 2005, 2007 and 2009).

The caliper readings are not being proposed from 2001 through 2003 during the near-term success monitoring to allow the trees time to acclimate with the new location and avoid taking caliper readings on trees that may die. The assumption is that a 3-year period should allow adequate time for the trees to recover from the transplanting activity and begin normal growth patterns. In addition, the trees that are alive after the initial 3-year period should be well established and survive.

5.1.2.2 Seed Propagation/Volunteer Recruitment

During the long-term monitoring events, qualitative observations will be made regarding seed propagation and volunteer recruitment in the project area. The propagation of seeds and the presence of volunteer species will be a sign that the natural succession process is working. As part of the study of volunteer recruitment, half of the forest plots will be planted with shrub species and half without. The

general condition of the shrub plots versus the non-shrub plots will be evaluated during the long-term monitoring. The amount of invasive species and volunteer recruitment will be evaluated qualitatively and comments will be included in the long-term monitoring reports.

5.1.2.3 Wildlife Use

Observations will also be made during the long-term monitoring events regarding wildlife using the area. A list of the wildlife observed in the project area will be compiled by DOE and the FDF Natural Resource Team and will be presented as part of the long-term monitoring reports.

5.2 MAINTENANCE

Regularly scheduled maintenance activities will be required to ensure both the near-term and long-term success of A8PII ecological restoration. These activities are discussed below.

5.2.1 Watering

Each plant will be watered at the time of installation as described in Section 4.2.5. Watering will be carried out beyond the initial planting if normal rainfall conditions do not occur (approximately 1 inch per week). Watering will be carried out using one of the following methods: direct watering of tree/shrub with hose or watering using tree gator or bucket. Water may be carried out during the second growing season if significant drought conditions occur similar to the summer of 1999. Under normal rainfall conditions, watering after planting should not be necessary.

5.2.2 Invasive/Aggressive Species Control

The establishment of invasive and aggressive species can be a significant problem in restored areas because they can out-compete desired species. Efforts will be employed to control invasive and aggressive species in the years immediately following restoration to give planted material the best chance to become established.

5.2.2.1 Near-Term Control

As part of the monitoring carried out during the first 3 years following restoration, invasive or aggressive species that require removal will be identified and flagged by the FDF Natural Resource Team. A8PII will be surveyed twice a year; once before June 1 and once after October 1. All honeysuckle and multiflora rose will be removed and/or sprayed. The first sweep is proposed for after October 1, 2000.

Semi-annual sweeps would continue until 2003. An initial herbicide application (Roundup®) of all existing grasses within planting areas will take place in November 1999.

5.2.2.2 Long-Term Control

During each long-term monitoring event, an assessment of invasive/aggressive species becoming established in A8PII will be made. Species that should be extirpated (e.g., bush honeysuckle, wild grape and thistle) will be identified. Site labor will be used to extirpate selected invasive/aggressive species using the E-Zject Lance or cutting as soon after the monitoring event as possible.

5.2.3 Deer Control

The deer population at the FEMP is currently under evaluation. The questions of whether deer populations are at levels high enough to warrant some type of population control is being evaluated. An evaluation of the impact of deer on the planted shrubs will be conducted as part of the near-term monitoring of the project area (e.g., mortality counts/plant survival). If the shrub plots show signs of significant mortality due to deer damage, DOE will implement more intensive deer controls.

5.2.4 Savanna Maintenance

In order for a savanna community to become established, periodic maintenance is required (Packard 1997). Controlled burning is optimal method for the maintenance of savannas and will be pursued as the maintenance tool for the A8PII oak savanna. Burning is the preferred method of maintenance for savannas because it rejuvenates prairie grasses by increasing available nutrients from the ash, it eliminates accumulated leaf litter that reflects sunlight, and if conducted in the spring, accelerates soil warming that will extend the growing season for prairie grasses (Packard 1997). In the event that controlled burns are not determined feasible at the FEMP, mowing and thatch removal can be used as a maintenance tool for savannas and will be used in A8PII (Packard 1997).

The A8PII Oak Savanna will be burned or mowed in two sections to minimize impacts to the insect population. One of the two sections will be burned or mowed every 3 years. If mowing is used as the maintenance tool, it will be accompanied by thatch removal using a rake or equivalent method. Maintenance of the savanna will occur until at least 2008, when restoration at the FEMP is scheduled to be complete.

6.0 PROJECT MANAGEMENT AND OVERSITE

The following sections describe the steps necessary to ensure that implementation of this NRRDP is conducted in a safe, quality manner, in accordance with all DOE, federal, state, and local requirements.

6.1 ENVIRONMENTAL COMPLIANCE

Applicable environmental control requirements for the project will be limited to the installation of erosion and sedimentation controls in accordance with the requirements specified in PL-3083, FEMP Stormwater Pollution Prevention Plan, and the control and abatement of fugitive dust emissions in accordance with RM-0047, Fugitive Dust Control Requirements.

Given the limited amount of soil disturbance associated with the project, project-specific erosion and sedimentation controls will consist of silt fence installed at the locations shown on the attached project drawings. Erosion and sedimentation controls will be inspected on a weekly basis under the PL-3083 construction inspection program. The wetland will be sized pursuant to Ohio Department of Natural Resources stormwater control requirements.

Fugitive dust control requirements specified under RM-0047 were developed from OEPA's fugitive dust control best available technology determination. Project-specific fugitive dust controls will consist primarily of water spray on exposed/working soil surfaces. Visual emission monitoring will be conducted and documented in accordance with the requirements specified in RM-0047.

6.2 SAFETY AND HEALTH

One person from the Occupational Safety and Health Department will be assigned to the project on a part-time basis. The Safety and Health (S&H) Representative will be responsible for integrating health and safety into all aspects of the project.

Safety and Health requirements for the construction phase of the project will be communicated in a Project Specific Health and Safety Matrix or Traveler Packet in accordance with RM-0021, Safety Performance Requirements Manual, and SH-0001, Development and Issue of Project Specific Health and Safety Requirements. SH-0001 also describes the FDF Work Permit process. Additionally, the S&H Representative assists in implementation of safety measures, and evaluation of process changes for

safety compliance. The S&H Representative conducts thorough preconstruction inspections of the work site and periodic walk-throughs once construction activities have begun.

FDF Fire Protection will provide consultation and guidance regarding fire protection and Life Safety Issues. As appropriate, Fire Protection provides necessary emergency response personnel and equipment for emergencies which could adversely affect people, property, or the environment. The FEMP Fire Protection functional area shall provide guidance to ensure that fire hazard issues are properly addressed and proper safeguards are in place for all activities associated with this project.

The S&H representative assigned to this project is responsible for integration and compliance with fire protection requirements as defined in PL-3020, FEMP Emergency Plan, and in RM-0013, Fire Protection Requirements Manual.

6.3 QUALITY ASSURANCE

Activities related to the implementation of the park will be conducted in accordance to the Quality Assurance Job-Specific Plan (QAJSP), described in Appendix E of the SEP (DOE 1998b). Quality Assurance personnel will ensure compliance with the QAJSP by performing surveillances and inspections necessary to verify work plan and construction design requirements. Objective evidence of assessments will be documented and become part of the park project records.

6.4 WASTE MANAGEMENT

During construction activities, field personnel will generate wastes. Management of waste streams will be coordinated with Waste Acceptance Organization through the Project Waste Identification Document process.

REFERENCES

Braun, E. L., 1934, A History of Ohio's Vegetation, Ohio Journal of Science, Volume 34, Pages 247-257.

Braun, E. L., 1941, The Differentiation of the Deciduous Forests of the Eastern United States, Ohio Journal of Science, Volume 41, Pages 235-241.

Braun, E. L., 1950, Deciduous Forests of Eastern North America, Blakiston Company, Philadelphia, Pennsylvania, page 596 (reprinted in 1964 by Hafner Publishing Company, New York.

Braun, E. L., 1961, The Woody Plants of Ohio: Trees, Shrubs, and Woody Climbers, Native, Naturalized, and Escaped, Ohio State University Press, Columbus, Ohio.

Ebasco Environmental, 1993, "Wetlands Delineation Report of the FEMP," Prepared for the U.S. Department of Energy, Fernald Field Office, Fernald, Ohio.

Facemire, C. F., S. I. Guttman, D. R. Osborne, and R. H. Sperger, 1990, Biological and Ecological Characterization of the Feed Materials Production Center, FMPC-SUB-018, Prepared for the U.S. Department of Energy, Fernald Field Office, Fernald, Ohio.

Gordon, R. B., 1966, Natural Vegetation of Ohio at the Time of Earliest Land Surveys," Bulletin of the Ohio Biological Survey, Ohio State University Press, Columbus, Ohio.

Gordon, R. B., 1969, The Natural Vegetation of Ohio in Pioneer Days, Bulletin of the Ohio Biological Survey, Ohio State University Press, Columbus, Ohio.

Hamilton County Park District, 1998, Plant List for Selected Park Lands, Hamilton County Park District, Cincinnati, Ohio.

Harker, D. F., G. Libby, K. Harker, S. Evans, 1998, Landscape Restoration Handbook, Lewis Publishers, Boca Raton, Florida.

Holl, 1998, Do Bird Perch Structures Elevate Seed Rain and Seedling Establishment in Abandoned Tropical Pastures?, Society for Ecological Restoration, Volume 6, Number 3.

Luken, J. O., 1990, Directing Ecological Succession, Chapman and Hall, London, England.

Munro, J., 1999, "Wetland Mitigation Plan for the Area 1, Phase I Mitigation Site, Fernald Environmental Management Project," Munro Ecological Services.

Ohio Environmental Protection Agency, 1998, "Crosby Township Land Survey from 1819," Ohio Environmental Protection Agency, Dayton, Ohio.

Ohio Environmental Protection Agency, 1999, "Sapling Densities for Oak Savanna," Personal Communication.

Packard, S., C. F. Mutel, 1997, The Tallgrass Restoration Handbook for Prairies, Savannas, and Woodlands, Island Press, Washington, D.C.

Pickert et. al., 1987, Models, Mechanisms, and Pathways of Succession, The Botanical Review, Volume 53, Number 3.

Rogers, R., 1990, Quercus Alba L. White Oak, Silvics of North America, Volume 2, Hardwoods, Agriculture Handbook, U.S.D.A. Forest Service, Washington, D.C.

Sauer, L. J., 1998, The Once and Future Forest, Island Press, Washington, D.C.

Sears, P. B., 1925, The Natural Vegetation of Ohio, A Map of the Virgin Forest, Ohio Journal of Science, Volume 25, Pages 139-149.

U.S.D.A. Soil Conservation Service, 1980, "Soil Survey of Butler County Ohio," Department of Natural Resources, Division of Lands and Soil and Ohio Agricultural Research and Development Center, Washington, D.C.

U.S.D.A. Soil Conservation Service, 1992, "Soil Bioengineering for Upland Slope Protection and Erosion Reduction," Field Engineering Handbook, Department of Natural Resources, Division of Lands and Soil and Ohio Agricultural Research and Development Center, Washington, D.C.

U.S. Department of Energy, 1998a, "Natural Resource Restoration Plan," Draft Final, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

U.S. Department of Energy, 1998b, "Sitewide Excavation Plan," Final, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

U.S. Department of Energy, 1998c, "Work Plan for Ecological Restoration Research Grants for Operable Unit 4 Supplemental Project," Final, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

U.S. Department of Energy, 1999, "Integrated Environmental Monitoring Plan," Revision 1, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

Yahner, R. H., 1995, "Eastern Deciduous Forests, Ecology and Wildlife Conservation," University of Minnesota Press, Minneapolis, Minnesota.

Table 1: Master Plant List

Scientific Name	Common Name	Plant Type	Qty.
Acer nigrum	black maple	overstory tree	23
Acer rubrum	red maple	overstory tree	62
Acer saccharinum	silver maple	overstory tree	15
Acer saccharum	sugar maple	overstory tree	98
Aesculus glabra	Ohio buckeye	overstory tree	22
Aesculus octandra	yellow buckeye	overstory tree	62
Asimina triloba	pawpaw	understory tree	8
Carpinus caroliniana	ironwood	understory tree	5
Carya cordiformis	bitternut hickory	overstory tree	11
Carya laciniosa	shellbark hickory	overstory tree	20
Carya ovata	shagbark hickory	overstory tree	34
Castanea dentata	chestnut	overstory tree	0*
Ceanothus americanus	New Jersey tea	shrub	24
Celtis occidentalis	hackberry	overstory tree	28
Cephalanthus occidentalis	buttonbush	shrub	18
Cercis canadensis	redbud	understory tree	13
Cornus drumondii	roughleaf dogwood	understory tree	4
Cornus florida	flowering dogwood	understory tree	13
Cornus racemosa	grey dogwood	understory tree	30
Corylus americana	hazel	shrub	41
Crataegus mollis	hawthorn	understory tree	4
Euonymus atropurpureus	burning bush	shrub	2
Fagus grandifolia	American beech	overstory tree	204
Fraxinus americana	white ash	overstory tree	87
Fraxinus pennsylvanica	green ash	overstory tree	41
Fraxinus quadrangulata	blue ash	overstory tree	0*
Gymnocladus dioica	Kentucky coffee tree	overstory tree	7
Hamamelis virginica	witch-hazel	shrub	28
Hypericum spathulatum	shrubby St. John's wort	shrub	33
Ilex veticallata	winterberry	shrub	17
Juglans cinerea	butternut	overstory tree	10
Juglans nigra	black walnut	overstory tree	30
Juniperus virginiana	red cedar	understory tree	30
Lindera benzoin	spicebush	shrub	29
Liquidambar styraciflua	sweetgum	overstory tree	3

Scientific Name	Common Name	Plant Type	Qty.
Liriodendron tulipifera	tulip poplar	overstory tree	26
Nyssa sylvatica	sourgum	overstory tree	11
Ostrya virginiana	hop hornbeam	understory tree	3
Physocarpus opulifolius	ninebark	shrub	23
Platanus occidentalis	sycamore	overstory tree	17
Populus deltoides	cottonwood	overstory tree	21
Prunus serotina	black cherry	overstory tree	34
Quercus alba	white oak	overstory tree	39
Quercus bicolor	swamp white oak	overstory tree	13
Quercus imbricaria	shingle oak	overstory tree	3
Quercus macrocarpa	bur oak	overstory tree	64
Quercus muhlenbergii	chinquapin oak	overstory tree	2
Quercus palustris	pin oak	overstory tree	26
Quercus prinus	chestnut oak	overstory tree	4
Quercus rubra	red oak	overstory tree	34
Quercus shumardii	Shumard oak	overstory tree	4
Quercus velutina	black oak	overstory tree	4
Rhus aromatica	fragrant sumac	shrub	20
Rhus glabra	smooth sumac	shrub	18
Rosa carolina	Carolina rose	shrub	21
Rosa palustris	swamp rose	shrub	15
Rosa setigera	prairie rose	shrub	15
Rubus occidentalis	black raspberry	shrub	16
Salix humila	pussy willow	shrub	15
Sambucus canadensis	elder	shrub	13
Sassafras albidum	sassafras	understory tree	3
Smilax rotundifolia	greenbrier	shrub	5
Staphylea trifolia	bladdernut	shrub	30
Symphoricarpos orbiculatus	corralberry	shrub	20
Tilia americana	American basswood	overstory tree	112
Ulmus americana	American elm	overstory tree	33
Viburnum acerifolium	maple leaf viburnum	shrub	14
Viburnum prunifolium	black-haw viburnum	shrub	27
Xanthozylum americanum	prickly ash	shrub	31

Total = 1,792

F 2689

Table 2
Oak - Sugar Maple Forest Type

Patch	OS1	OS2	OS3	OS4	Total
Trees	44	49	47	46	186
Shrubs	25	0	26	0	51
Acres	0.25	0.26	0.26	0.25	1.02

Scientific Name	Common Name	Plant Type					
Acer nigrum	black maple	overstory tree	5	5	5	5	20
Acer saccharum	sugar maple	overstory tree	5	5	5	5	20
Aesculus glabra	Ohio buckeye	overstory tree	1	1		1	3
Asimina triloba	pawpaw	understory tree		1	1	1	3
Carpinus caroliniana	ironwood	understory tree	1	1	1		3
Carya cordiformis	bitternut hickory	overstory tree	2	3	3	2	10
Carya laciniosa	shellbark hickory	overstory tree	1	3	3	4	11
Carya ovata	shagbark hickory	overstory tree	2	3	2	3	10
Fraxinus americana	white ash	overstory tree	3	4	4	4	15
Juglans nigra	black walnut	overstory tree	5	5	5	6	21
Liriodendron tulipifera	tulip poplar	overstory tree	1	1	1		3
Prunus serotina	black cherry	overstory tree	3	3	3	2	11
Quercus alba	white oak	overstory tree	5	5	5	5	20
Quercus imbricaria	shingle oak	overstory tree		0		1	1
Quercus prinus	chestnut oak	overstory tree	1	1	1		3
Quercus rubra	red oak	overstory tree	6	5	5	5	21
Quercus velutina	black oak	overstory tree	1	1	1		3
Tilia americana	American basswood	overstory tree	2	2	2	2	8
Ceanothus americanus	New Jersey tea	shrub			5		5
Corylus americana	hazel	shrub			5		5
Rhus glabra	smooth sumac	shrub	4				4
Rosa carolina	Carolina rose	shrub			5		5
Salix humila	pussy willow	shrub	4				4
Sambucus canadensis	elder	shrub	4				4
Smilax rotundifolia	greenbrier	shrub	5				5
Symphoricarpos orbiculatus	corralberry	shrub	5				5
Viburnum acerifolium	maple-leaf viburnum	shrub			5		5
Xanthozylum americanum	prickly ash	shrub	3		6		9

Table 3
Mesophytic Forest Type

		Patch	MM8	MM9	MM10	MM11	MM12	MM13	MM14	MM19	MM20	MM21	MM22	Total
		Trees	43	48	48	47	45	45	45	41	40	45	48	495
		Shrubs	24	0	27	0	25	0	25	23	0	25	0	149
		Acres	0.26	0.26	0.26	0.25	0.26	0.25	0.26	0.25	0.23	0.25	0.26	2.79
Scientific Name	Common Name	Plant Type												
Acer rubrum	red maple	overstory tree	3	3	3	4	4	3	4	3	4	3	4	38
Acer saccharinum	silver maple	overstory tree	1	1	1	2			1					6
Acer saccharum	sugar maple	overstory tree								1	1	1		3
Aesculus glabra	Ohio buckeye	overstory tree	1	1	1	1								4
Aesculus octandra	yellow buckeye	overstory tree	6	6	5	5	5	6	6	6	5	6	6	62
Carya ovata	shagbark hickory	overstory tree		1	1	1	1	2	1	1	1	1	2	12
Celtis occidentalis	hackberry	overstory tree	3	2	2	2	2	2	3	3	2	2	2	25
Cornus racemosa	grey dogwood	understory tree		3	3	3	3							12
Fagus grandifolia	American beech	overstory tree	5	5	5	5	5	5	5	5	4	4	4	52
Fraxinus americana	white ash	overstory tree	5	5	5	5	5	5	5	5	5	5	6	56
Fraxinus pennsylvanica	green ash	overstory tree						3				3	2	8
Gymnocladus dioica	Kentucky coffee tree	overstory tree	1				1		1					3
Juglans cinerea	butternut	overstory tree	1	1	1	1	1	1	1	1		1	1	10
Juglans nigra	black walnut	overstory tree	1	1	1	1	1	1	1		1	1		9
Liquidambar styraciflua	sweetgum	overstory tree									1	1	1	3
Liriodendron tulipifera	tulip poplar	overstory tree								1		1	1	3
Nyssa sylvatica	sourgum	overstory tree					1	1	1					3
Platanus occidentalis	sycamore	overstory tree	1	1	1									3
Prunus serotina	black cherry	overstory tree	2	2	2	2	2	2	2	2		2	2	20
Quercus alba	white oak	overstory tree									1		1	2
Quercus imbricaria	shingle oak	overstory tree						1						1
Quercus muhlenbergii	chinquapin oak	overstory tree	1								1			2
Quercus palustris	pin oak	overstory tree		3	3	3					2	2	2	15
Quercus rubra	red oak	overstory tree			1	1	1	1	1	1	1	1	1	9
Quercus shumardii	Shumard oak	overstory tree					1	1	1	1				4
Sassafras albidum	sassafras	understory tree		1								1	1	3
Tilia americana	American basswood	overstory tree	10	10	10	9	9	9	10	9	9	8	10	103
Ulmus americana	American elm	overstory tree	2	2	3	2	3	2	2	2	2	2	2	24
Corylus americana	hazel	shrub	5						5	4		5		19
Hamamelis virginica	witch-hazel	shrub	5		5		4		4					18
Hypericum spathulatum	shrubby St. John's wort	shrub			5		4		5			4		18
Ilex veticallata	winterberry	shrub					6			5		4		15
Lindera benzoin	spice bush	shrub	5				6		5	5				21
Rosa palustris	swamp rose	shrub			5		5			5				15
Rubus occidentalis	black raspberry	shrub	4		6							6		16
Viburnum prunifolium	black-haw viburnum	shrub	5		6				6	4		6		27

Table 4
Beech - Maple Forest Type

	Patch	BS23	BS24	BS25	BS26	BS27	BS28	BS29	BS30	Total
	Trees	43	38	49	36	39	35	32	32	304
	Shrubs	24	0	27	0	22	0	17	0	90
	Acres	0.25	0.22	0.29	0.21	0.23	0.21	0.18	0.18	1.77
Scientific Name	Common Name	Plant Type								
Acer nigrum	black maple	overstory tree						1		1
Acer rubrum	red maple	overstory tree			1					1
Acer saccharinum	silver maple	overstory tree	2	1	2	2	2			9
Acer saccharum	sugar maple	overstory tree	11	9	13	9	9	9	7	8	75
Aesculus glabra	Ohio buckeye	overstory tree					1				1
Asimina triloba	pawpaw	understory tree	1								1
Carpinus caroliniana	ironwood	understory tree						1	1		2
Carya cordiformis	bitternut hickory	overstory tree			1						1
Carya laciniosa	shellbark hickory	overstory tree		1							1
Carya ovata	shagbark hickory	overstory tree	1	1						2	4
Celtis occidentalis	hackberry	overstory tree	1	1	1						3
Cornus florida	flowering dogwood	understory tree								1	1
Fagus grandifolia	American beech	overstory tree	21	20	24	16	19	19	16	17	152
Fraxinus americana	white ash	overstory tree	2	2	2	1	2	1	1	1	12
Liriodendron tulipifera	tulip poplar	overstory tree	2	2	3	2	2	2	2	1	16
Nyssa sylvatica	sourgum	overstory tree		1	1	1	1	1	1		6
Ostrya virginiana	hop hornbeam	understory tree						1	1	1	3
Prunus serotina	black cherry	overstory tree			1	1	1				3
Quercus alba	white oak	overstory tree				1	1				2
Quercus imbricaria	shingle oak	overstory tree							1		1
Quercus prinus	chestnut oak	overstory tree				1					1
Quercus velutina	black oak	overstory tree				1					1
Tilia americana	American basswood	overstory tree	1								1
Ulmus americana	American elm	overstory tree	1			1	1	1	1	1	6
Hamamelis virginica	witch-hazel	Shrub			6				4		10
Rhus aromatica	fragrant sumac	Shrub	5		5		4				14
Rhus glabra	smooth sumac	Shrub			5				3		8
Rosa carolina	Carolina rose	Shrub	5				5				10
Salix humila	pussy willow	Shrub	4				4		3		11
Sambucus canadensis	elder	Shrub			5				4		9
Staphylea trifolia	bladdernut	Shrub			6				3		9
Symphoricarpos orbiculatus	corralberry	Shrub	5				5				10
Viburnum acerifolium	maple-leaf viburnum	Shrub	5				4				9

639000

1-2689

Table 5
Oak Savanna Habitat Type

		Patch	SV1	SV2	SV3	SV4	SV5	SV6	SV7	SV8	SV9	SV10	Total
		Trees	6	8	8	9	7	11	11	8	8	8	84
		Shrubs	6	8	8	9	7	11	11	8	8	8	84
		Acres	0.27	0.26	0.25	0.27	0.24	0.23	0.22	0.23	0.28	0.24	2.49
Scientific Name	common Name	Plant Type											
Quercus alba	white oak	overstory tree		3	3					3	3	3	15
Quercus bicolor	swamp white oak	overstory tree				3	2	2	2				9
Quercus macrocarpa	bur oak	overstory tree	6	5	5	6	5	9	9	5	5	5	60
Ceanothus americanus	New Jersey tea	shrub	2	2	2	3		3	2	2	3		19
Cephalanthus occidentalis	buttonbush	shrub				3	4	3	3		3	2	18
Corylus americana	hazel	shrub	2	3	3			2		3	2	2	17
Hypericum spathulatum	shrubby St. John's wort	shrub				3	3	3	4			2	15
Rosa setigera	prairie rose	shrub	2	3	3				2	3		2	15

Table 6
Buffer

Patch	BF31
Trees	77
Shrubs	23
Acres	0.25

Scientific Name	Common Name	Plant Type	
Cercis canadensis	redbud	understory tree	8
Cornus florida	flowering dogwood	understory tree	8
Crataegus mollis	hawthorne	understory tree	4
Fraxinus americana	white ash	overstory tree	4
Gymnocladus dioica	Kentucky coffee tree	overstory tree	4
Juniperus virginiana	red cedar	understory tree	30
Liriodendron tulipifera	tulip poplar	overstory tree	4
Populus deltoides	cottonwood	overstory tree	4
Quercus macrocarpa	bur oak	overstory tree	4
Quercus rubra	red oak	overstory tree	4
Ulmus americana	American elm	overstory tree	3
Rhus glabra	smooth sumac	shrub	6
Rhus aromatica	fragrant sumac	shrub	6
Rosa carolina	Carolina rose	shrub	6
Symphoricarpos orbiculatus	coralberry	shrub	5

Table 7
Existing Riparian Forest

Patch	RP1	RP2	RP3	RP4	RP5	Total
Trees	30	73	20	20	28	171
Shrubs	0	49	12	0	17	78
Acres	0.37	1.01	1.09	1.42	0.50	4.39

Scientific Name	common Name	Plant Type						
Acer nigrum	black maple	overstory tree			2			2
Acer rubrum	red maple	overstory tree	5	13			5	23
Aesculus glabra	Ohio buckeye	overstory tree	3	8			3	14
Asimina triloba	pawpaw	understory tree			2	2		4
Carya laciniosa	shellbark hickory	overstory tree			4	4		8
Carya ovata	shagbark hickory	overstory tree			4	4		8
Cercis canadensis	redbud	understory tree		3		2		5
Cornus drumondii	roughleaf dogwood	understory tree			2	2		4
Cornus florida	flowering dogwood	understory tree			2	2		4
Cornus racemosa	grey dogwood	understory tree	5	10			3	18
Fraxinus pennsylvanicum	green ash	overstory tree	7	17		2	7	33
Nyssa sylvatica	black gum	overstory tree			2			2
Platanus occidentalis	sycamore	overstory tree	3	6			5	14
Populus deltoides	cottonwood	overstory tree	4	8			5	17
Quercus bicolor	swamp white oak	overstory tree			2	2		4
Quercus palustris	pin oak	overstory tree	3	8				11
Euonymus atropurpureus	burning bush	shrub			2			2
Ilex verticallata	winterberry	shrub			2			2
Lindera benzoin	spicebush	shrub		4	4			8
Physocarpus opulifolius	ninebark	shrub		15	2		6	23
Staphylea trifolia	bladdernut	shrub		14	2		5	21
Xanthozylum americanum	prickly ash	shrub		16			6	22

Table 8: Forest Type Grass Seed Mix

Scientific Name	Common Name	Rate (Lbs pls/Acre)
Andropogon gerardii	big bluestem	6
Bouteloua curtipendula	side-oats grama	1
Elymus canadensis	Canada wild rye	4
Panicum virgatum	switch grass	1
Schzachyrium scoparium	little bluestem	4
Sorghastrum nutans	Indian grass	4
	Total =	20

2689

Table 9: Oak Savanna Seed Mix

Scientific Name	Common Name	Rate (Lbs pls/Acre)
Andropogon gerardii	big bluestem	6
Calamagrostis canadensis	blue-joint grass	1
Carex festucacea	fescue sedge	1
Carex lacustris	lake bank sedge	1
Carex normalis	large straw sedge	1
Carex stricta	tussock sedge	1
Elymus canadensis	Canada wild rye	4
Panicum virgatum	switch grass	1
Schzachyrium scoparium	little bluestem	4
Sorghastrum nutans	Indian grass	4
Spartina pectinata	prairie cordgrass	1
Amorpha canescens	lead plant	*
Asclepias sulivantii	Sullivant's milkweed	*
Asclepias tuberosa	butterfly weed	*
Babtisia bracteata lecophaea	cream wild indigo	*
Dalea purpureum	purple prairie clover	*
Didecantheon meadia	shooting star	*
Echinacea purpurea	purple coneflower	*
Eryngium yuccifolium	rattlesnake master	*
Hypoxis hirsuta	yellow star grass	*
Lespedeza capitata	round-headed bush clover	*
Liatris aspera	rough blazing star	*
Lilium michiganense	Michigan lilly	*
Lobela spicata	pale spiked lobelia	*
Lysmachia ciliata	fringed loostrife	*
Lysmachia quadriflora	narrow leaved loostrife	*
Monarda fistulosa	wild bergamot	*
Penstemon digitalis	foxglove penstemon	*
Ratibida pinnata	grey-headed coneflower	*
Rudbeckia hirta	black-eyed Susan	*
Solidago rigida	stiff goldenrod	*
Siliphium terebinthinaceum	prairie dock	*
Sisyrinchium agustifolium	pointed blue-eyed grass	*
Tradescantia ohiensis	Ohio spiderwort	*
Veronicastrum virginicum	Culver's root	*

*Forbs will be added to the seed mix, pursuant to availability

Total = 25

2689

Table 10: Vernal Pool Seed Mix

Scientific Name	Common Name	Rate (Lbs pls/Acre)
Carex frankii	Frank's sedge	2
Carex lacustris	lake sedge	2
Carex lurida	bottlebrush sedge	2
Carex stipata	awl-fruited sedge	2
Carex stricta	tussock sedge	2
Carex vulpinoidea	fox sedge	2
Glyceria striata	fowl manna grass	2
Juncus effusus	soft rush	2
Scirpus cyperinus	woolgrass	2
Spartina pectinata	prairie cordgrass	2
	Total =	20

2689

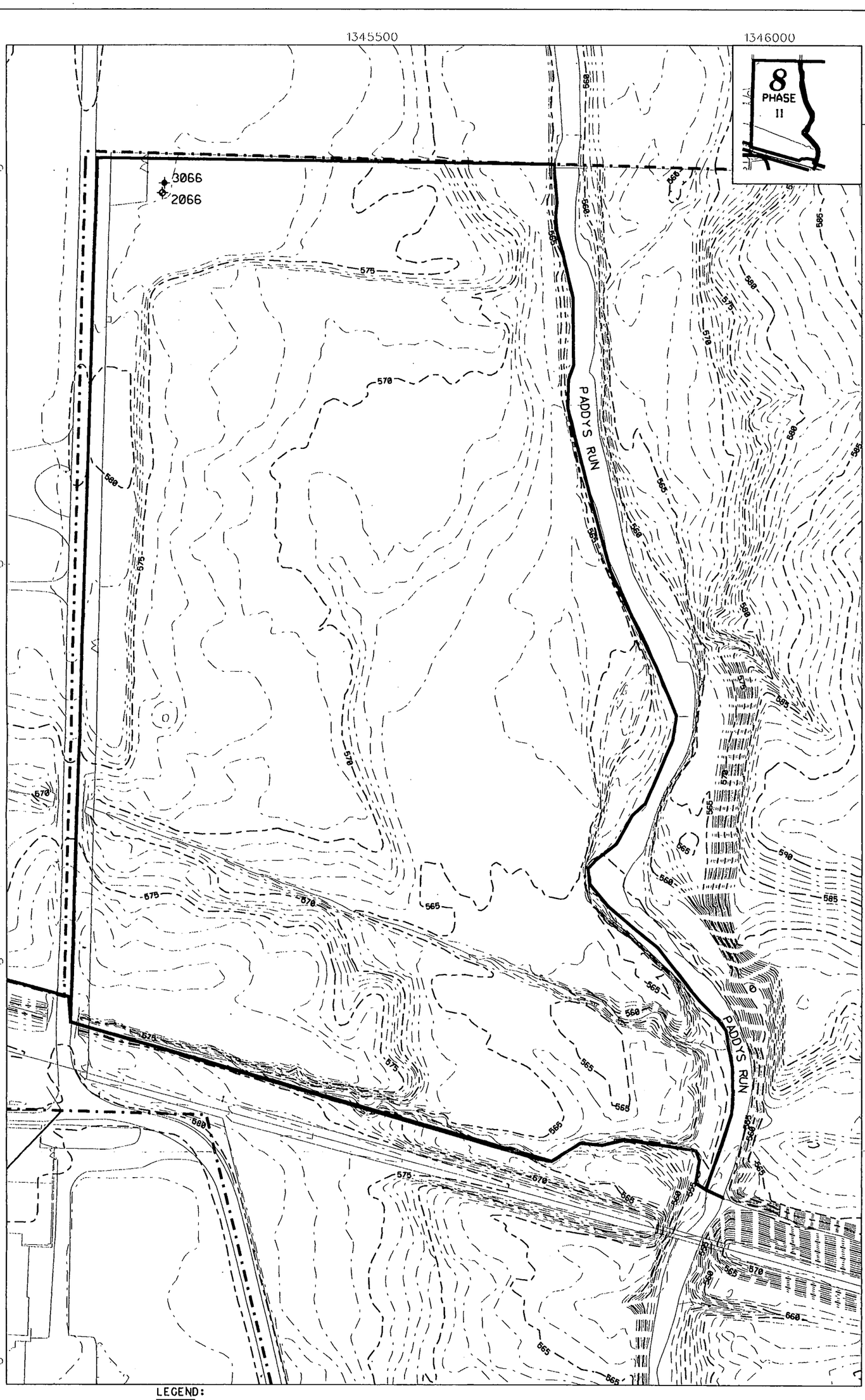
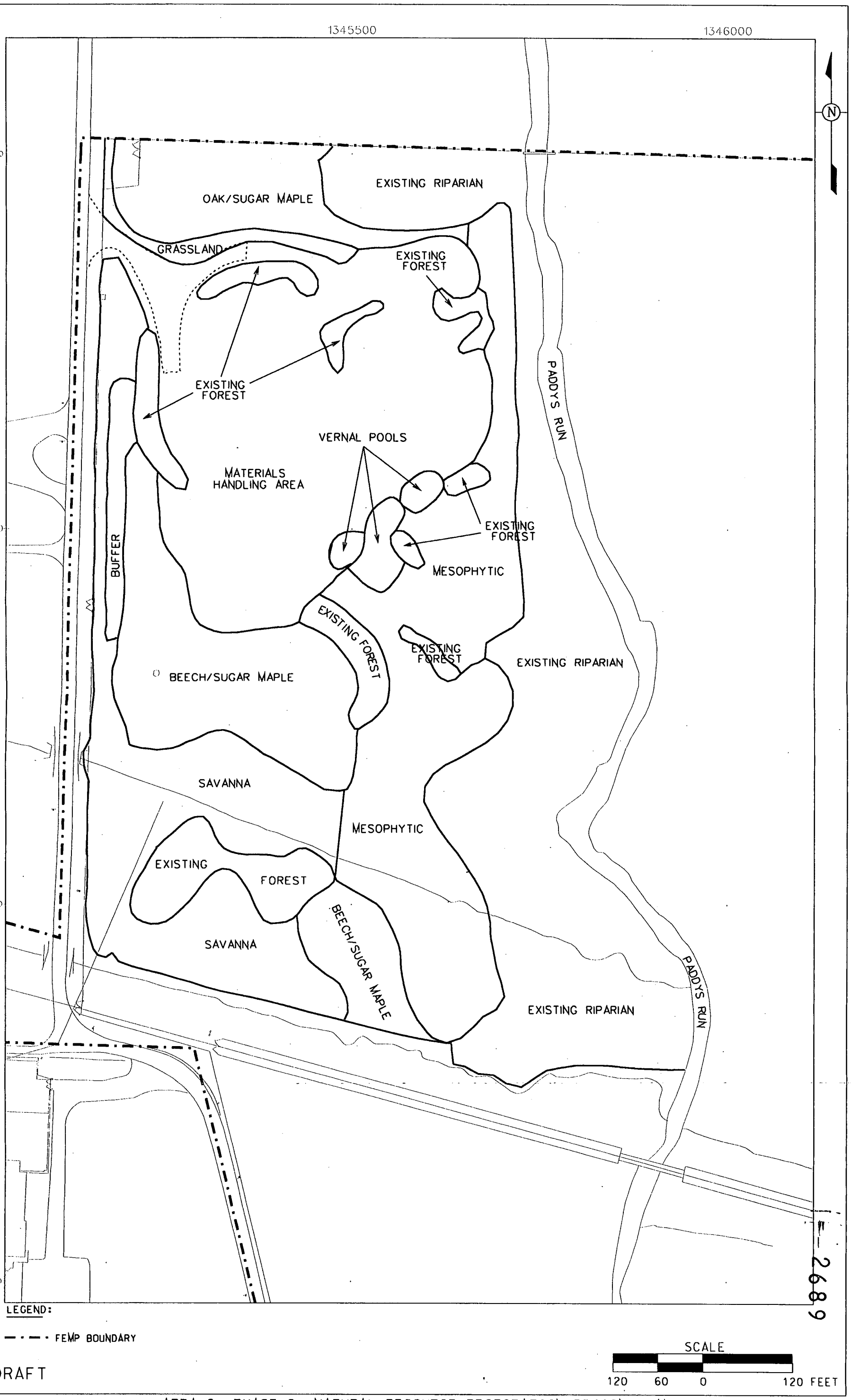


FIGURE 1. AREA 8 PHASE II MATERAL RESOURCE RESTORATION DESIGN PLAN
CURRENT TOPOGRAPHY AND SITE FEATURES



AREA 8. PHASE 2. NATURAL RESOURCE RESTORATION DESIGN PLAN
FIGURE 2. HABITAT TYPES

v:\e2fm12\eggnea8p2p1nt3.dgn

1345500

1346000

8
PHASE
II

N

3066
2066

PADDYS RUN

PADDYS RUN

484000

483500

483000

82500

STATE PLANAR COORDINATE SYSTEM 1983

14-DEC-1999

LEGEND:

- FEMP BOUNDARY
- ACCESS ROAD BOUNDARY
- DRAINAGE SWALE (CENTERLINE)
- GENERAL LOCATION OF ADDITIONAL VERNAL POOL

SCALE

120 60 0 120 FEET

DRAFT

8000068

2689

FIGURE 3. AREA 8 PHASE II MATERAL RESOURCE RESTORATION DESIGN PLAN
ACCESS ROAD AND MATERIALS HANDLING AREA

1345500

1346000

484000

483500

483000

482500

STATE PLANAR COORDINATE SYSTEM 1983

OS 1

OS 2
(NO SHRUB)

OS 3

OS 4
(NO SHRUB)

RP 5

RP 1
(NO SHRUB)

GL 32

MM 8

EF

AMS NO
PLANT ZONE

SV 8

BF 31

EF

VERNAL POOLS

EF

MM 9
(NO SHRUB)

EF

MM 10

RP 2

BS 23

MM 12

MM 11
(NO SHRUB)

BS 24
(NO SHRUB)

BS 26
NO SHRUB)

EF

EF

BS 25

BS 27

MM 14

SV 9

BS 28
(NO SHRUB)

MM 13
(NO SHRUB)

SV 5

SV 4

SV 6

SV 7

MM 19

RP 3

SV 10

EF

MM 20
(NO SHRUB)

SV 2

BS 29

MM 21

SV 1

SV 3

BS 30
(NO SHRUB)

MM 22
(NO SHRUB)

RP 4
(NO SHRUB)

PADDYS RUN

PADDYS RUN

N

LEGEND:

FEMP BOUNDARY

MM = MESOPHYTIC
BS = BEECH/SUGAR MAPLE
OS = OAK/SUGAR MAPLE
BF = BUFFER
GL = GRASSLAND

SV = SAVANNA
RP = EXISTING RIPARIAN
EF = EXISTING FOREST

SCALE

120 60 0 120 FEET

DRAFT

14-DEC-1999

F-2689

AREA 8. PHASE 2. NATURAL RESOURCE RESTORATION DESIGN PLAN
FIGURE 4. PLANTING PLAN

APPENDIX A

PLANTING SPECIFICATIONS

2689

APPENDIX A
AREA 8, PHASE II NATURAL RESOURCE DESIGN PLAN
PLANTING SPECIFICATIONS

A.1 INSTALLATION OF PLANT MATERIAL

A.1.1 Planting Locations

Planting locations will be flagged in the field by the FEMP Restoration Ecologist. The Restoration Ecologist is the FDF Personnel responsible for identifying the location of all plant material installation, verifying acceptance of delivered plant material, and ensuring proper installation.

A.1.2 Plant Installation Season

A.1.2.1 Unless otherwise approved by the Restoration Ecologist, all plant installation shall take place between September 15 and December 15 or February 15 and May 15.

A.1.2.2 Restoration Ecologist may restrict planting activities in response to actual conditions (e.g., droughts, unseasonable freezes).

A.1.2.3 No plant installation may take place while the soil surface is frozen.

A.1.3 Installation of Balled and Burlapped Trees and Shrubs (Detail A-1)

A.1.3.1 Excavate planting pit to a depth such that the top of the ball, when planted, extends 1 to 2 inches above ground surface.

A.1.3.2 Excavate planting pit so that it is wider than root ball by 9 inches on each side.

A.1.3.3 Scarify sides of planting pit with shovel.

A.1.3.4 Loosen burlap from around base of trunk, but do not remove.

A.1.3.5 Set trees and shrubs such that the top of ball extends 1-2 inches above ground surface and that trunk is vertical. Trunks shall have no more than 10 percent lean.

A.1.3.6 Backfill with a mixture of the topsoil and subsoil removed when the pit was excavated. Gently tamp the backfill as it is placed into pit.

A.1.3.7 Water immediately after planting to saturate the upper 12 inches of soil.

A.1.3.8 Remove any tags, labels, and strings from the plant.

A.1.4 Installation of Container-Grown Trees and Shrubs (Detail A-1)

000051

A.1.4.1 Excavate planting pit to a depth such that the top of the root ball, when removed From the container and planted, extends 1 to 2 inches above ground surface.

A.1.4.2 Excavate planting pit so that it is wider than root ball (when removed from the container) by 9 inches on each side.

A.1.4.3 Scarify sides of planting pit with shovel.

A.1.4.4 Remove plant by carefully inverting the container, cutting if necessary. Attempt to keep the ball as intact as possible.

A.1.4.5 Set the plant such that the top of ball extends 1 to 2 inches above ground surface and that trunk is vertical. Trunks shall have no more than 10 percent lean.

A.1.4.6 Backfill with a mixture of the topsoil and subsoil removed when the pit was excavated. Gently tamp the backfill as it is placed into pit.

A.1.4.7 Water immediately after planting to saturate the upper 12 inches of soil.

A.1.4.8 Remove any tags, labels, and strings from the plant.

A.1.5 Installation of Bareroot Plants (Detail A-2)

A.1.5.1 Carry bareroot plants in a bucket of water (or moist sand or other moist medium) in the field to keep roots from drying out.

A.1.5.2 Excavate planting pit only broad enough to accommodate the roots when fully extended and only deep enough such that the uppermost roots will be just below ground surface.

A.1.5.3 Set the plant and spread the roots in a natural pattern such that the roots are fully extended without touching the sides of the planting pit and that the uppermost roots are just below ground surface.

A.1.5.4 Carefully work backfill (mix of topsoil and subsoil removed from the planting pit) through the fully spread root systems and water while backfilling.

A.1.5.5 Firmly tamp backfill with heel of shoe when complete.

A.1.5.6 Remove any tags, labels, and strings from the plant.

A.1.6 Pruning

A.1.6.1 Once trees and shrubs are planted, prune off any dead or damaged limbs.

A.1.6.2 All pruning shall involve removal of limbs back to a lateral branch or bud.

A.1.6.3 Perform additional pruning at the request of the Restoration Ecologist.

A.2 MULCHING

Apply a 4-inch layer of hardwood mulch over a circular area 4 feet in diameter surrounding balled and burlapped and container grown trees and shrubs. At the discretion of the Restoration Ecologist, straw may be used as a substitute for hardwood mulch.

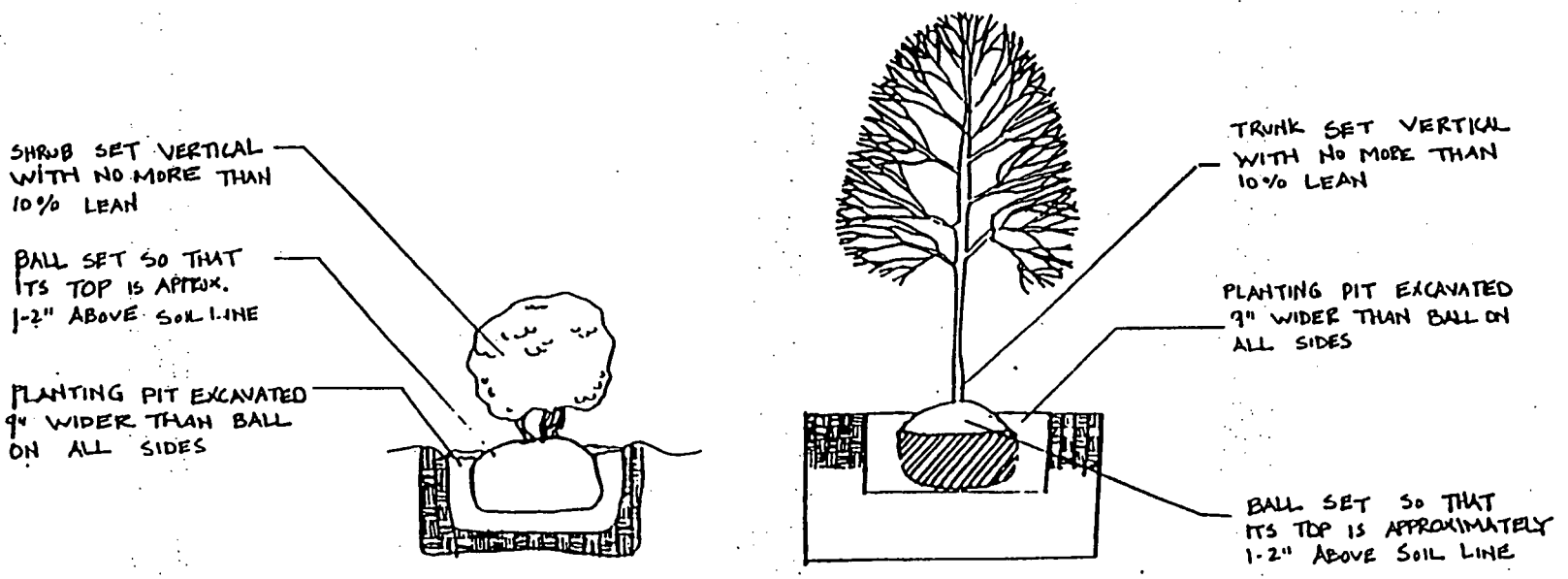
A.2.1 Apply a 4-inch layer of hardwood mulch over a circular area 2 feet in diameter surrounding each bare root or peat pot plant. At the discretion of the Restoration Ecologist, straw may be used as a substitute for hardwood mulch.

A.2.2 Mulch shall be placed so as to not physically contact the plants.

A.3 STAKING AND GUYING

Trees shall only be staked and guyed at the request of the Restoration Ecologist.

Detail A-1: Installation of Balled and Burlapped and Container-Grown Trees and Shrubs



Detail A-2: Installation of Bareroot Plants